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ARBUTUS BICOLOR (ERICACEAE, ARBUTEAE), A NEW SPECIES FROM MEXICO

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ABSTRACT

Arbutus bicolor S. González, M. González et P. D. Sørensen, sp. nov. is described and illustrated. It is related to *A. xalapensis* H.B.K. and has been generally misidentified as *A. glandulosa* M. Martens & Galeotti, a synonym of the latter name. The new species is distinguished by having densely glandular pubescent branchlets and petioles; markedly bicolored leaves that are whitish to pale ochroleucous below due to a dense and uniform indument of tightly curled hairs, leaves red at senescence; and pink, rarely white flowers. *Arbutus bicolor* is widely distributed in the Sierra Madre Occidental and the Transvolcanic Belt and reaches the western slopes of the Sierra Madre Oriental in central Mexico. Sporadic hybridization occurs with *A. madrensis* S. González, *A. occidentalis* McVaugh & Rosatti, *A. tessellata* Sørensen, and *A. xalapensis*. A key to distinguish *A. bicolor* from other Mexican tree species of *Arbutus* is provided.

Key words: *Arbutus glandulosa, Arbutus xalapensis*, hybridization, madrone, systematics.

RESUMEN

Se describe e ilustra a *Arbutus bicolor* S. González, M. González et P. D. Sørensen, sp. nov., especie relacionada con *A. xalapensis* H.B.K., que ha sido por largo tiempo identificada erróneamente como *A. glandulosa* M. Martens & Galeotti, un sinónimo de

esta última. Se diferencia de *A. xalapensis* por tener las ramillas y pecíolos densamente glandular pubescentes, las hojas marcadamente bicolores con envés blanquecino a ocre pálido debido a la presencia de indumento denso y uniforme de pelos apretadamente crespos, las hojas de color rojo intenso en la senescencia, así como las flores de color rosa o raramente blanco. *Arbutus bicolor* está ampliamente distribuida en la Sierra Madre Occidental y el Eje Neovolcánico, alcanzando la vertiente occidental de la Sierra Madre Oriental. Se registran híbridos esporádicos con *A. madrensis* S. González, *A. occidentalis* McVaugh & Rosatti, *A. tessellata* Sørensen y *A. xalapensis*. Se incluye una clave para distinguir a *A. bicolor* de otras especies arbóreas de *Arbutus* de México.

Palabras clave: *Arbutus glandulosa, Arbutus xalapensis*, hibridación, madroño, sistemática.

Arbutus L. (Ericaceae, Arbuteae) includes at least 12 species, three occur in the Mediterranean Basin and along the western coast of Europe, one in the Canary Islands, and eight in North and Central America, where the genus is an important element of pine-oak forest. *Arbutus menziesii* Pursh is known from the west coast of North America, but the greatest species diversity of the genus is found in Mexico, where seven species with an extraordinary diversity of forms and confused taxonomy are known. Three of these Mexican species have been described in the last three decades: *Arbutus occidentalis* (McVaugh & Rosatti, 1978), *A. tessellata* (Sørensen, 1987), and *A. madrensis* (González Elizondo & González Elizondo, 1992) and a fourth species (*Arbutus mollis* H.B.K.) will be resurrected after almost a century of being considered as a synonym of *A. xalapensis* (González-Elizondo et al., in rev.). With respect to the remaining Mexican species, *A. arizonica* (A. Gray) Sarg. is known from the SW United States to Central Mexico and *A. xalapensis* is a broadly variable taxon known from SW United States to Central America. The seventh Mexican species, twelfth for the genus, is described herein for plants that have been generally misidentified as *A. glandulosa*.

Arbutus bicolor S. González, M. González et P. D. Sørensen, sp. nov. *Arbutus glandulosa* of authors, non *A. glandulosa* M. Martens & Galeotti.

Species nova *A. xalapensi* H.B.K. similis a qua differt ramulis et petiolis pubescentibus trichomatibus glandulosis, foliis discoloribus subtus incanis vel ochroleucis dense trichomatibus crispatis tectis, et floribus roseis raro albis (Fig. 1, 2).

Fig. 1. *Arbutus bicolor*. A. branchlet and leaves; B. branchlet and leaves, lower surface; C. habit, with fruit; D. inflorescence.

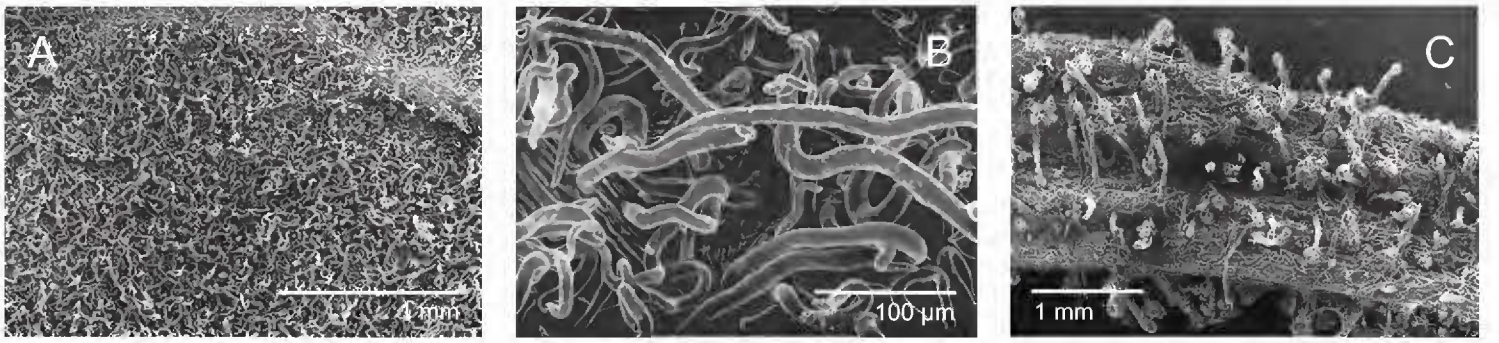

Fig. 2. *Arbutus bicolor,* SEM images. A. indument of lower surface of leaves. B. indument of lower surface of leaves; C. petiole. Scale bar: A and C = 1 mm; B = 100 µm.

Trees 4-25 m tall; bark exfoliating in smooth flakes over most larger limbs, the inner bark smooth, creamy, pale rose to dark cinnamon, the bark on base of trunk and eventually over the oldest parts of plant retained as pale gray, checkered, isodiametric or rectangular segments; bark of second-year branchlets soon exfoliating, leaving the inner bark smooth, reddish to dark-cinnamon sometimes with some glaucous cover; twigs of current year and petioles densely glandular pubescent, the glandular hairs 0.2-1.5(-2.5) mm long, mixed with eglandular hoary pubescence of shorter and curled hairs. Petioles (1.5-)2-6 cm long; leaf blades ovate, rarely oblong or oblong-lanceolate, 6-14 cm long, 4-9.5 cm wide, apex rounded to shortly acute, base cordate, truncate or rounded, often slightly asymmetrical, margin entire or irregularly serrate particularly on sprout leaves, blades bicolored, above dark green (turning red at senescence), opaque or slightly glossy, sparsely short glandular pubescent with or without additional eglandular whitish hairs, rarely glabrescent, the veinlets raised forming small areoles that give an irregular aspect to the minutely papillous surface, lower surface of blade creamy to ochroleucous because a dense and uniform indument of short, tightly and irregularly curled hairs hides the surface, often also with glandular hairs 0.2-0.3 mm long on the surface and longer glandular hairs (up to 1.5 mm long) along the midvein. Inflorescence a terminal cluster of racemes, showy, up to 13 cm long and to 16 cm wide, usually openly-branched, rarely with only 2-3 racemes, branches 2-9 cm long, 2-4 cm wide; axes densely hairy, with both glandular hairs and short eglandular hairs intermixed; pedicels accrescent and elongated in fruit, up to 15 mm long, with both glandular and eglandular hairs; bracts ovate to lanceolate, widened at the base, yellowish to purplish or dark reddish, densely short pubescent with glandular hairs and crispy eglandular hairs, 3-11 mm long, 2.3-4.6 mm wide including the margin that can be dark and scarious or concolorous and not scarious; two inner bracteoles 2-3 mm long, pubescent at least on the

middle portion and margins. Flowers: calyx lobes 1.2-2.4(-3.5) mm long, apex acute or obtuse, often pink to pale purplish, ciliate; corolla 5.6-9 mm long, 5-7 mm wide, pink, rarely white or white with pink tinge (immature flowers sometimes recorded by collectors as white reddish or creamy with salmon tinge), pubescent or glabrous outside, lobes auriculate imbricate at the base, reflexed at anthesis; base of filaments densely villous with white hairs 0.4-0.8 mm long, anthers 1.1-1.5 mm, dehiscent by pores 1/3-1/2 the length of the thecae, spurs 0.6-1.2 mm, occasionally bearing a short spur at the base, also occasionally a diminutive (0.2-0.4 mm long) translucent appendix is present between the pores. Berries orange to deep red or purple-red, up to 9 mm long and 7-10 mm in diam.

Type: MEXICO. Durango: municipio El Mezquital: al NE de Taxicaringa, por el camino a Durango, 23°14' N, 104°45' W, 30 Apr 1992, 2600 m, *M. González 2636* (holotype: CIIDIR, isotypes to be distributed).

Common names: madroño, madroño rojo. Uses (rarely recorded): an infusion for drink is made with the leaves; the fruits are edible in small amounts (large quantities cause dizziness).

Arbutus bicolor is related to *A. xalapensis* and specimens have been usually identified as *A. glandulosa* M. Martens & Galeotti, a glandular morph of the former species that Sørensen (1995) appropriately reduced to synonymy. The glandular and eglandular morphs of *A. xalapensis* occur sometimes in the same population, a situation observed even at the type locality of the species near Xalapa, Veracruz. *Arbutus bicolor* can be distinguished from *A. xalapensis* (including its glandular morphs) by the following combination of characters: a) twigs of current year and petioles densely glandular pubescent, the glandular hairs mixed with eglandular hoary pubescence of shorter and curled hairs (vs. eglandular or glandular, villous, lacking in hoary pubescence); b) markedly bicolored leaves that are whitish to pale ochroleucous below due to a dense and uniform indument of tightly and irregularly contorted hairs (vs. sparse indument of flexuous, often twisted and/or floccose hairs); and c) pink, rarely white flowers (vs. white, creamy, yellowish or greenish, rarely rose flowers). Branch limbs in *A. bicolor* are somewhat ascending, forming a relatively narrow crown and the bark is usually rose creamy to cinnamon; *A. xalapensis* has ascendant or spreading limbs, a broad or narrow crown, and orange, rose, or creamy bark. *Arbutus bicolor* is prone to fungus infections, with the glands of twigs and petioles usually blackened because fungus growth and the indument of the lower

surface of leaves very often spotted with dark, circular colonies of fungi. *Arbutus bicolor* does not fit into any of the other synonymous taxa noted in Sørensen's Flora Neotropica treatment.

McVaugh & Rosatti (1978) noted that plants called *A. glandulosa* in western Mexico differed in several aspects from "everything in the complex of *A. xalapensis*", for example, they are copiously beset with gland-tipped hairs (1-)2-4(-7) mm long and rough, flaking, but persistent bark that often contrasts markedly with the smooth bark of *A. xalapensis*. Those features correspond to *A. tessellata*, another conspicuously glandular species (Sørensen, 1987). The main differences between *A. bicolor* and other Mexican tree species of *Arbutus* are presented in a key below.

The ecological preferences of *A. bicolor* and *A. xalapensis* also are different. The former species develops in sites with colder climates than *A. xalapensis*. In the Sierra Madre Occidental, for example, *A. bicolor* grows at higher elevations (2200-3300 m) on the interior-facing and eastern slopes whereas *A. xalapensis* is restricted to middle elevations (1500-2700 m) of the western slopes of the range, where warm-temperate climates are prevalent, although occasionally both species can be quasi-sympatric in ecotones between their preferred habitats. The habitat of the southernmost known population of *A. bicolor* (Puebla, *Calzada et al. 04688)* is described as "very cold, with strong winds from the north."

Distribution and habitat: *Arbutus bicolor* is widely distributed in the Sierra Madre Occidental and the Transvolcanic Belt, reaching the western slopes of the Sierra Madre Oriental in central Mexico. It is known from Chihuahua and Durango to Distrito Federal and Puebla (Fig. 3). *Arbutus bicolor* evidently prefers humid slopes and ravines in conifer (*Abies-Pinus*), pine, pine-oak, or oak forest, but also develops in sclerophylous scrub with *Quercus, Arctostaphylos* and *Garrya* and in "subalpine" grassland, as well as in rough, stony hills with pine-oak or pine-juniper dry forest. Some of the associations in which *A. bicolor* becomes abundant are: at the Sierra Madre Occidental: a) *Abies durangensis, Pinus cooperi, P. ayacahuite, Quercus sideroxyla, Populus tremuloides*; b) *Quercus sideroxyla* with *P. durangensis, P. ayacahuite* and *Q. crassifolia*; c) *Quercus sideroxyla* with *P. teocote* and *Q. rugosa* with *Juniperus deppeana* understory; d) *Pinus teocote*; e) *Pinus teocote* with *P. arizonica, Q. crassifolia, Q. rugosa, Q. obtusata*, and *P. ayacahuite*; f) *Pinus lumholtzii-Quercus* spp., all those on slopes and ravines; and g) *Pinus cooperi* and/or *P. leiophylla* on mountain valleys. In central México: a) *Pinus rudis-Quercus* spp.-*Arbutus* spp. b) *Pinus cembroides-Juniperus flaccida.* Alt. 2200-3400 m. Flowering February-June (July), fruiting all year round, mainly May-November but fruits persisting.

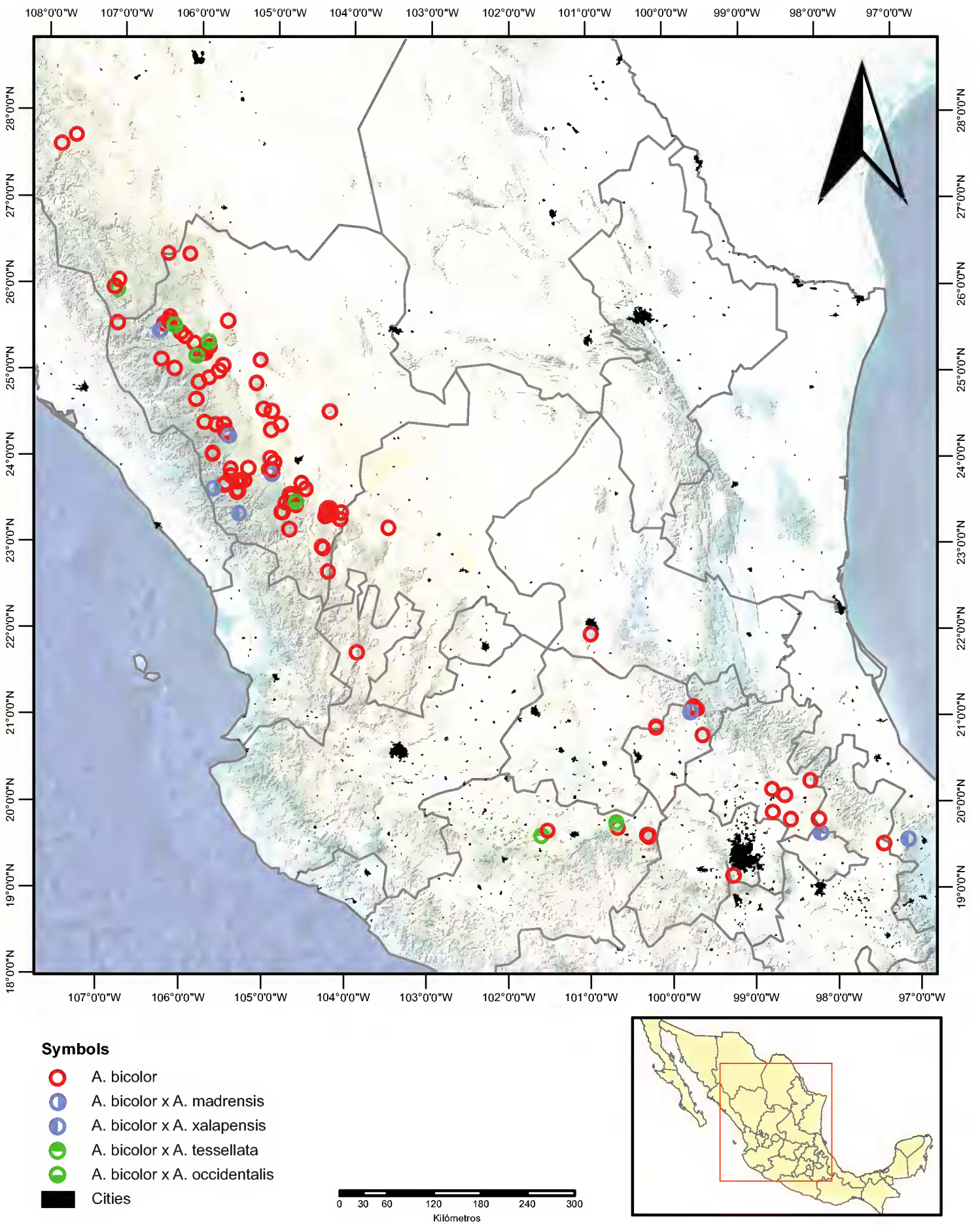

Fig. 3. Distribution of *Arbutus bicolor* and putative hybrids.

Additional specimens examined: **Mexico**. **Chihuahua**: municipio Bocoyna: Bocoyna, on mesa west of Creel, between Creel and rio Oteros, 2360 m, *R. Bye y W. A. Weber 8197* (MEXU, MICH); Bocoyna, ejido San Ignacio Arareco, *R. A. Bye 8527* (MEXU); W of Creel toward Sierrita Blanca, on Creel-Sánchez road, *R. Bye 9529* (MEXU); NE of San Ignacio Arareco, N of old road between San Ignacio and Panalachic, *R. A. Bye 3058, 3061* (MEXU); above arroyo del Ojito between Choguita and Cusarare, *R. A. Bye 3173* (MEXU); municipio Balleza: El Vergel, al S, 0.3 km de Cueva Blanca, km 128.5 carret. 24 Parral - Guadalupe y Calvo tramo El Vergel - Ciénega Larga, 26°22'41" N, 106°22'5" W, *S. González s.n., D. Ramírez, S. Tena y A. Mastretta* (CIIDIR); El Vergel, *J. J. Luna 6* (CHAPA, ENCB); municipio Guadalupe y Calvo: Cerro Mohinora, 10 mi SW of Guadalupe y Calvo, *R. Straw & M. Forman 1960* (MICH); ibid., entronque del camino a la cima con la carretera Guadalupe y Calvo - Bovorigame, 26°4'16" N, 106°58'32" W, *S. González 7354c A. Ayala y D. Stancik* (CIIDIR, IEB, MEXU); ibid., cañada por el camino a la cima, 25°58'36" N, 107°2'42" W, *S. González 7351, A. Ayala y D. Stancik* (CHIH, CIIDIR, IEB, MEXU). **Durango**: municipio Guanaceví: Cerro Barajas, cima, 26º23'30" N, 106º5'0" W, 3310 m, 24.08.2004, *S. González 6996, M. González, M. A. Márquez, O. Cázares* (CIIDIR, DEK); municipio Tamazula: ejido El Tecuán, parte alta del Desmonte de Enrique, al SO de la comunidad San Juan del Tecuán, 25°34'42" N, 106°59'16" W, 2605 m, 02.04.2008, *F. Mercado 254 D. Ramírez N. y E. Borgas* (CIIDIR); municipio Tepehuanes: Las Conchitas, vivero, al W, cerca de arroyo, El Tarahumar, 25°39'40" N, 106°19'35" W, 2575 m, *S. Acevedo 922* (CIIDIR); El Santo Niño, El Tarahumar, Cordón Mocho al N del 2º vivero, a orilla del vivero, 25°39'20" N, 106°19'5" W, *S. Acevedo 865 y 866* (CIIDIR); El Tarahumar, a un lado del vivero No. 1, 25°39' N, 106°19' W, *S. Acevedo 846 y 847* (CIIDIR); falda de la Manga Quemada, bajada del Santo Niño, 6 km al SE de La Atascosa, comunidad de El Tarahumar, *E. Guízar N. 2149* (MEXU); El Huacal, 29 km por el camino a El Tarahuamar, 25°36' N, 106°19' W, *M. González 2619* (CIIDIR); Altos de Yesqueros, camino de El Huacal a Quebrada Honda, 25°34' N, 106°24' W, *M. González 2453, 2454, 2456, 2458, 2462* (CIIDIR); Bajío de Los Arcos, por el camino de El Huacal a Quebrada Honda, 25°29' N, 106°27' W, *M. González 2490 y 2495* (CIIDIR); 3 km de El Huacal, por el camino a El Tarahumar, 25°28' N, 106°11' W, *M. González 2448, 2449, 2450, 2451* (CIIDIR); 73 km de Tepehuanes, por el camino a El Huacal, 25°25' N, 106°7' W, *M. González 2438* (CIIDIR); ibid., *2439* (CIIDIR, DEK, MEXU); ibid., *2441, 2444, 2445* (CIIDIR); Tepehuanes, 56 km por el camino a El Huacal, 25°21' N, 106°0' W, *M. González 2427, 2428, 2431, 2433, 2434* (CIIDIR); ibid., a 3 km de la Ciénega del Fraile, *M. González 2425, 2426* (CIIDIR); 44 km de Tepehuanes, por el

camino a El Huacal, 25°14' N, 105°52' W, *M. González 2422, 2423, 2424* (CIIDIR); Llanito de Buenos Aires, Mesa de Navar, 25°14' N, 105°55' W, *E. Guizar 2108* (CHAP, CIIDIR, MEXU); 3 km de Arroyo Chico, sobre el camino Tepehuanes - El Huacal, *A. Benítez y O. Bravo 394* (CHAP, CIIDIR, MEXU); Cuevecillas, 0.5 km del campamento de la UAF Topia, 25°9' N, 106°25' W, *O. Bravo 1154* (CIIDIR, CHAP); Buenos Aires, 36 km al W de Tepehuanes, por la brecha a Topia, *P. Tenorio 1169 y C. Romero de T.* (ENCB, MEXU); 21 km al W de Tepehuanes, brecha a Tabahueto, *P. Tenorio et al. 4186* (CIIDIR, MEXU); Boleras, 10 km al SE, rumbo a la Sierra de la Candela, 25°37' N, 105°25' W, *S. González 5209, 5215* (CIIDIR); municipio Topia: Cuevecillas, 0.5 km antes de llegar al pueblo, 25°9' N, 106°25' W, *A. Benítez 2469* (CHAP, CIIDIR); Cuevecillas, atrás del campamento de la UAF Topia, 25°9' N, 106°25' W, *A. Benítez 2335* (CHAP, CIIDIR, IEB); municipio Santiago Papasquiaro: 135 km de Santiago Papasquiaro, por el camino a Canelas, 25° N, 106° W, *S. González, S. Acevedo y J. Panero 4949* (CIIDIR); 54 km de Altares, por el camino a Canelas, 25°3' N, 106°15' W, *S. González, S. Acevedo y J. Panero 4996* (CIIDIR); Santiago Papasquiaro, aprox. 40 km al W por el camino a Canelas, 25°06' N, 105°38' W, *S. González 4930, 4932 S. Acevedo* (CIIDIR); Las Ranas, camino Santiago Papasquiaro - Los Altares, *E. Guízar 2393* (CHAP, CIIDIR, IEB, MEXU); Las Ranas, camino Santiago Papasquiaro - Los Altares, 25°2' N, 105°41' W, *E. Guízar 1013* (CIIDIR, CHAP, MEXU); municipio El Oro: Sierra de Promontorio, al NE de El Encinal, por el camino a la mina de Promontorio, 25°10'47" N, 105°09'41" W, *S. González 6783, P. M. Peterson, L. E. Brothers* (CIIDIR, IEB, MEXU, US); municipio Otáez: El Castillito, camino a Otáez, 24°57' N, 105°48' W, *E. Guízar 2387* (CIIDIR); proximidades a la desviación Piélagos - Otáez (infl reducida a dos racimos), *E. Guízar 2365* (CHAP, CIIDIR, IEB); proximidad de Bajío de Vacas, ej. Las Hacienditas, 24°54' N, 105°56' W, *E. Guízar 2379* (CHAP. CIIDIR); municipio Nuevo Ideal: Cañada del Gato, sierra en Nuevo Ideal, 24°54'3" N, 105°12'34" W, *A. García A. 3538* (CIIDIR); municipio San Dimas: Vencedores, área 43, 24°25' N, 105°42' W, *S. González 5146, M. A. Márquez* (CIIDIR); La Guitarra, *Lote 4,* 24°25" N, 105°36" W, *S. González 5579 M. A. Márquez y M. González* (CIIDIR); Los Aposentos, 2.5 km al NE de San Miguel de Cruces, *A. García, M. González y S. Acevedo 427* (CIIDIR, IEB); Las Pintas, La Pista, 24°19' N, 105°34' W, *S. González 7321a, R. Silva, F. Maciel, S. Ortega R., M. Soto* (CIIDIR); Miravalles, UCODEFO 4, 24°17' N, 105°32' W, *S. González 5119 y M. A. Márquez* (CIIDIR); Cerro Huehuento, vertiente N, 24°4'45" N, 105°44'37" W, *S. González s.n., M. González, A. Torres, L. Ruacho, G. Medrano, S. Heines, I. Estrada, E. Larreta* (CIIDIR); Cerro Huehuento, al S de Huachichiles, 1 km al NNW de la cima, 24°4'42" N, 105°44'35" W, *S. Gon-*

zález 6845 (CIIDIR); Cerro Huehuento, sobre vertiente N, 24°4'39" N, 105°44'29" W, *S. González 7720, M. González, A. Torres, L. Ruacho, G. Medrano, S. Heines, I. Estrada, E. Larreta* (CIIDIR); Cerro Huehuento, S of Huachichiles, *J. H. Maysilles 7286* (MICH); San Luis del Río, 51 road mi northwest of Coyotes, *J. H. Maysilles 7234* (MICH); ibid. *7974* (MEXU, MICH); municipio Canatlán: Sierra del Epazote, cima del cerro de las antenas, 24°36'12" N, 105°6'37" W, *M. G. Nava Miranda 148, J. Noriega, G. M. Valtierra y L. Ruacho* (CIIDIR); Sierra del Epazote, ±2.5 km de La Cieneguita por el camino a la Ciénega de la Casa, 24°35'26" N, 105°0'22" W, *M. González 3369, R. Álvarez Z. y C. López G.* (CIIDIR); rancho El Durangueño, ejido Nogales, punto 33, 24°26'5" N, 104°53'13" W, *A. Garza Herrera s.n., F. Sánchez, D. Mata, A. Arvizu, S. González* (CIIDIR, IBUG); Sierra del Epazote, rancho El Durangueño, 24°22'14" N, 105°0'16" W, *S. González 6292, M. A. Márquez y C. López* (CIIDIR); municipio Pánuco de Coronado: Sierra de Gamón, ladera NW, cerca de la cima, 24°35'21" N, 104°16'45" W, *S. González 7383, L. López, L. Reséndiz, D. Ramírez, F. Mercado, M. Ramírez y L. A. Ramírez* (CIIDIR); municipio Durango: ejido La Esperanza, 23°55'31" N, 105°17'54" W, *A. García 4359* (CIIDIR, HUAA); Otinapa, 23°59'11" N, 104°57'42" W, *M. Flores 7-OT* (CIIDIR); ibid., *M. Flores 8-OT* (CIIDIR); Otinapa, al S, 23°59'11" N, 104°57'42" W, *S. González 7646, J. Giménez de Azcárate, M. A. Macías* (CIIDIR); parque El Tecuán, junto a Las Conchas viejas y las cabañas abandonadas, 23°54' N, 105°30' W, *S. Acevedo 1194* (CIIDIR, IEB); parque El Tecuán, extremo E de Mesa del Mirador, 23°54'9" N, 105°01'50" W, *S. González 5785, A. García y S. Acevedo* (CIIDIR); parque El Tecuán, alrededores, carretera Durango - El Salto, 23°54' N, 105°1' W, *A. Román 5 y 6 S. González* (CIIDIR); parque El Tecuán, 58 km de Durango, *F. Casillas et al. 89* (CIIDIR); 35 mi W of Durango, on rt. 40, *W. Hess & M. Hall* (MICH); Subcuenca Santiago Bayacora, La Mesa Alta, Sitio 5, 23°45'4" N, 104°36'31" W, *J. Acevedo Herrera 198* (CIIDIR); Subcuenca Santiago Bayacora, La Mesa de los Difuntos, sitio 4, 23°41'19" N, 104°33'50" W, *J. Acevedo Herrera 191* (CIIDIR); Subcuenca Santiago Bayacora, Pilares, sitio 4, 23°35'11" N, 104°44'38" W, *J. Acevedo Herrera 60* (CIIDIR); Subcuenca Santiago Bayacora, Al S de los Bajíos de Don Víctor, 23°30'19" N, 104°40'2" W, *J. Acevedo Herrera 202* (CIIDIR); Mesa de Tableteros, 23°37'29" N, 104°44'25" W, *S. González s.n., L. Ruacho, N. González, O. Rosales, G. Medrano V. y D. Salinas* (CIIDIR); Carboneras, al NE, al SW de La Flor, 23°31'29" N, 104°48'32" W, *S. González 7703, L. Ruacho, N. González, O. Rosales, G. Medrano y D. Salinas* (CIIDIR); La Flor, al W, 23°31'27" N, 104°48'28" W, *S. González s.n. et al.* (CIIDIR); municipio Pueblo Nuevo: El Salto, ca. 2 km al W, al S de la carretera 40 Durango - Mazatlán, 23°46'43" N, 105°23'6" W, *S. González 7633, J. Giménez de Azcárate, M.*

A. Macías (CIIDIR); región de El Salto, *G. Guzmán et al.* 18.IX.1961 (ENCB); Santa Bárbara, 6 km por el camino a El Salto, 23º45' N, 105º25' W, *A. García 1093 S. González* (CIIDIR, IEB); Arroyo Santa Bárbara, al SW de El Salto, 23°39' N, 105°25' W, *S. González 5260* (CIIDIR); Peñitas, aprox. 13 km al SW de El Salto, 23º39' N, 105º24' W, *M. González 4010 y 4002 M. Flores V., S. Quiñones* (CIIDIR); Santa Bárbara, al S, por el camino a El Sótano, al W del camino a Pueblo Nuevo, 23°38'26" N, 105°25'26" W, *S. González 6823 P. M. Peterson y G. Tena* (CIIDIR); Coyotes Hacienda, 63 mi of C. Durango, *J. Maysilles 7721* (MICH); ejido El Brillante, la cañada de *Picea*, carretera Durango - Mazatlán, km 99, 23°46' N, 105°20' W, *Equipo 2 Fac. Ciencias Forestales s.n.* (CIIDIR); Km 1119, road Durango-Mazatlán, 999 ft, *Weedons M665* (MEXU); La Ermita, aprox. 100 m al W, cerca del km 158.5 de carretera Durango - Mazatlán, 23°40'22" N, 105°43'35" W, *S. González 6938, J. Á. Villarreal y L. Chávez* (CIIDIR); Buenos Aires, 7 km al W, extremo W del poblado La Ermita, 23º40'13" N, 105º43'25" W *S. González 6009a J. Panero* (CIIDIR, IEB); Chavarría (cercanías del entronque a), km 131 carretera Durango - Mazatlán, 23°44' N, 105°34' W, *S. y M. González 4883* (CIIDIR); ibid., km 134, 23°43' N, 105°35' W, *S. y M. González 4882* (CIIDIR); 26 km al W de El Salto, *S. González y A. Lux 4435* (CIIDIR); arroyo La Tecolota, predio Las Bayas de la UJED, 23°25' N, 104°51' W, *A. García A. 1036* (CIIDIR, IEB); municipio Súchil: Reserva de la Biosfera La Michilía, Cerro Blanco, Playa Grande, 23°28'48" N, 104°16'26" W, *G. Amacio 12-1* (CIIDIR); ibid., 23°28'19" N, 104°16'19" W, *G. Amacio 9-2* (CIIDIR); Reserva de la Biosfera La Michilía, Cerro Blanco, Cordón de las Venadas, 23°28'4" N, 104°15'59" W, *G. Amancio 22-1* (CIIDIR); ibid., *G. Amancio 22-3* (CIIDIR); ibid., *G. Amancio 23-2* (CIIDIR); ibid., *G. Amancio 23-3* (CIIDIR); ibid., 23°27'46" N, 104°16'4", *G. Amancio 20-2* (CIIDIR); Reserva de la Biosfera La Michilía, Cerro Blanco, Encina Gorda, 23°27'49" N, 104°15'48" W, *G. Amacio 15-3* (CIIDIR); ibid., *G. Amacio 15-4* (CIIDIR); ibid., Encina Gorda, 23°27'35" N, 104°16'1" W, *G. Amacio 13-4* (CIIDIR*);* Reserva de la Biosfera La Michilía, Cerro Blanco, punto Cacahuates, al S del cerro Magueycitos, 23°27' N, 104°16' W, *J. Alvarado 290* (CIIDIR, IEB); Reserva de la Biosfera La Michilía, Cerro Blanco, 23º27' N, 104º17' W, *S. González 3736* (CIIDIR); Reserva de la Biosfera La Michilía, Ciénega de Los Caballos, 23°26'43" N, 104°15'53" W, *J. M. Ibarra M. A8* (CIIDIR); Reserva de la Biosfera La Michilía, Cordón de las Culebras, *S. y M. González 4795* (CIIDIR); Reserva de la Biosfera La Michilía, vados de El Taray, *S. y M. González 4737* (CIIDIR); ibid., Mesa de San Antonio, *L. Jamieson 10* (CIIDIR); ibid., *L. Jamieson 44* (CIIDIR); ibid., *L. Jamieson 56* (CIIDIR); ibid., *L. Jamieson 181* (CIIDIR); Mesa de San Antonio, cerca del Taray, *L. Jamieson 227* (CIIDIR); arroyo El Taray, al SE, al pie de La Mesa El Bu-

rro, *S. Acevedo 427 D. Bayona* (CIIDIR); Reserva de la Biosfera La Michilía, Mesa de San Antonio hacia la Mesa El Burro, *S. González y L. Jamieson 4270 y 4273* (CIIDIR); Reserva de la Biosfera La Michilía, Mesa El Burro, 23°23' N, 104°17' W, *R. Fernández 1117* (CIIDIR, ENCB); Reserva de la Biosfera La Michilía, W, *L. Jamieson 682* (CIIDIR); ibid., *L. Jamieson 989* (CIIDIR); ibid., *L. Jamieson 468* (CIIDIR); ibid., *L. Jamieson 319, 354, 382, 399* (CIIDIR); Reserva de la Biosfera La Michilía, arroyo El Ranchero, bajada, al SW de la reserva, 23°22'20" N, 104°18'53" W, *S. González 4748, 4749 M. González* (CIIDIR); Reserva de la Biosfera La Michilía, El Pujido, *S. González y L. Jamieson 4277* (CIIDIR); Reserva La Michilía, Toribia, *M. E. Maury, V. Serrano y S. Gallina 23* (IEB); Reserva de la Biosfera La Michilía, arroyo El Pajonal, 23° N, 104° W, *L. Rentería 5 y A. García* (CIIDIR); arroyo El Ranchero, al S de la Reserva La Michilía, *S. y M. González 4745* (CIIDIR); Cerro Las Iglesias, 7 km de El Alemán, *F. Acevedo 113* (CIIDIR); cordón de la Sierra de Urica, atrás del cerro Chihuahuilla, 23°25' N, 104°6' W, *J. M. Ibarra M. Arl* (CIIDIR); municipio El Mezquital: La Escondida, km 64 del camino que va a Los Charcos, camino a El Mezquital, *S. Acevedo 435 D. Bayona* (CIIDIR, IEB); Francisco I. Madero (Pajaritos), al N, en pico S de cerro, cerca de camino maderero abandonado, 22°44'36" N, 104°15'48" W, *S. González 6470 P. M. Peterson* (CIIDIR). **Zacatecas**: municipio Sombrerete: Laguna Balderrama, *J. D. Webster 2* (MICH). **San Luis Potosí**: municipio Villa de Reyes: Sierra de San Miguelito, *M. F. Robert y J. Passini 891* (ENCB). **Guanajuato**: municipio San José Iturbide: mountains ESE of San José Iturbide and about 5 mi W of Cerro Zamorano, *R. McVaugh 10389* (MICH); municipio Tierra Blanca: Cerro Zamorano, vertiente E (NE), *E. Carranza y S. Zamudio 4015* (IEB); ibid., bosque de *Abies-Quercus*, ladera de cerro, 2800-3050 m, *E. Carranza y S. Zamudio 4017* (CIIDIR, IEB). **Querétaro**: municipio Peñamiller: parte alta del Cerro Pingüical, 2 km al W de la antena, *S. Zamudio y E. Carranza 6882* (IEB); ladera S del Cerro Pingüical, 3000 m, *S. Zamudio y S. González 11727, 11728, 11729, 11730* (IEB); municipio Pinal de Amoles: cerro La Calentura, *S. Zamudio 3636* (IEB, QMEX); brecha 3 km carretera a Querétaro, Puerto de los Velázquez, Ejido Barranca, *J. Huerta y L. Arellanes s.n.* (ENCB); municipio Colón: parte alta del Cerro Zamorano, *S. Zamudio y E. Pérez 7738* (IEB); ibid., 20°56.01' N, 100°10.50' W, 3300 m, *S. Zamudio y E. Pérez 11839* (IEB); parte media del Cerro Zamorano, ladera SE, 20°55' N, 100°16' W, 3170 m, *M. Gómez S., D. Flores y L.S. Calderón 567* (IEB); en el camino de Los Trigos a las antenas de Televisa, *R. Chávez 68* (QMEX); municipio Cadereyta: 4 km al E de La Laja, Sierra de El Doctor, 2940 m, *S. Zamudio y E. Carranza 6407* (IEB); 2 km al S de Sombrerete, *L. Hernández 4567* (QMEX). **Michoacán**: municipio Quiroga: Cerro Tzirate, *C. López 1159*

(ENCB, IEB); parte alta del Cerro Tzirate, *H. Díaz Barriga y S. Zamudio 2798* (IEB); ibid., 19°43'46" N, 101°30'57" W, 3250 m, 29.12.2007, *S. Zamudio y cols. 14057* (IEB); municipio Hidalgo: Ciudad Hidalgo, *S. D. Koch 77373 y P. A. Fryxell* (CHAPA); municipio Angangueo: Llano del Toro, 22.I.1987, *M. Mejía s.n.* (IEB); Sierra Chincua, Reserva de la Biosfera Mariposa Monarca, 19°40'35" N, 100°18'04" W, *M. G. Cornejo Tenorio 299 y G. Ibarra Manríquez* (IEB); ibid., alrededores del vivero forestal, 19°40' N, 100°16'53" W, 2910 m, bosque de coníferas (*Abies religiosa*), *S. Rangel Landa 248, M. A. García Guzmán y G. Ibarra Manríquez* (CIIDIR, IEB). **Hidalgo**: municipio El Chico: Las Ventanas, 5.5 km al N de Pachuca, *M. Medina 2273* (ENCB, IEB); municipio Tulancingo: Cuyamaloya, norte de Tulancingo, *E. Matuda 37605* (IEB); municipio Tepeapulco: cerro de Xihuingo, *A. Ventura 475* (ENCB); cerro Xihuingo, *A. Ventura 1047* (ENCB); municipio Zempoala: cerro de Los Pitos, *A. Ventura 1641* (MEXU); municipio Epazoyucan: Sierra de Los Pitos, Tlaquilpan, *G. Benítez 191* (IEB); 1 km al SW de El Guajolote, *M. Medina y M. Á. Barrios 2579* (IEB). **Distrito Federal**: Sur del Xilte Grande, *M. A. Panti 22* (ENCB); Pedregal Camposanto, Temamatla, *E. Ibarra 118* (MEXU); San Miguel Ajusco, Tlalpan, *J. C. Soto Nuñez 13011* (MEXU). **Puebla**: municipio Chignahuapan: ejido San Luis del Valle, 19°48'08" N, 98°11'28" W, *E. Guízar N. y A. G. Miranda M. 5950* (MEXU); municipio Tepeyahualco: volcán de Pizarro, 6 km al 60' de Tepeyahualco, 19°30' N, 97°6' W, *J. I. Calzada, F. Lozano, E. Martínez, y J. Gallardo 04688* (MEXU).

Key to the Mexican tree species of *Arbutus*

1 Twigs of current year and petioles with conspicuous glandular hairs more prominent than eglandular hairs 2

2 Leaves dark green above, creamy to ochroleucous below as a dense indumentum of tightly curled hairs uniformly obscures the surface, leaves at senescence red; corolla pink, rarely white ..... *Arbutus bicolor*

2 Leaves olive green, bright or pale green above, or somewhat glaucous, pale green below, pubescent with flexuous hairs not tightly curled nor obscuring the surface, leaves at senescence yellow, orange or rarely red; corolla white, creamy, yellowish or greenish 3

3 Older twigs rough; bark retained as pale gray, checkered, thick isodiametric or rectangular segments on the trunk, limbs, and twigs of the previous seasons, or exfoliating on young twigs and therefore shed in small, roug-

hened flakes; glandular hairs 1-4(-6.8) mm long, averaging ca. 2.5 mm long ..... *Arbutus tessellata*

3 Older twigs smooth; bark exfoliating in smooth flakes at least on limbs and twigs of the previous seasons, or retained as pale gray, checkered segments only on the trunk and base of the older limbs; glandular hairs 0.2-1.5(-2) mm long, averaging ca. 1 mm long .... *Arbutus xalapensis* (glandular morphs)

1 Twigs of current year and petioles eglandular, or if glandular hairs present those seen only with a hand lens (10x) or at higher magnifications.

4 Twigs of the current year and petioles purplish-red, rose, or pale green with rose tinge, petioles either glabrous, puberulent or shortly pubescent with white-gray hairs often only on the upper surface of mature leaves; leaves tapered to rounded at base, lower surface glabrous, puberulent, or hoary only along the midvein ..... *Arbutus arizonica*

4 Twigs of the current year and petioles variously coloured, rarely (in *A. xalapensis* var. *texana*) rose or purplish, pubescent to villous on both upper and lower surfaces; leaves rounded, subtruncate, slightly cordate or slightly tapered at base, lower surface pubescent to villous, rarely glabrous 5

5 Bark exfoliating in smooth flakes at least on limbs and twigs of the previous seasons, or only retained as gray, checkered segments on the older parts of trunk and limbs; older twigs smooth, rarely slightly roughened; leaves 2.3-9 cm wide, the upper surface in various shades of green but rarely dark green, at senescence yellow, orangish, or red .... *Arbutus xalapensis*

5 Bark retained as gray, checkered, thick isodiametric or rectangular segments on the trunk, limbs, and twigs of the previous seasons, or rarely exfoliating on young twigs and shed in small, roughened flakes and the twigs roughened; leaves 5-9 cm wide, the upper surface dark green, at senescence bright red ..... *Arbutus madrensis*

Hybridization is common among taxa of *Arbutus*. The hybrids, although fertile, are usually found as isolated occurrences. Occasionally, backcrossing occurs and several grades of introgression are found, particularly in disturbed areas. An example of a hybrid swarm between *A. bicolor* and *A. xalapensis* var. *texana* (Buckl.) A. Gray is found in cerro El Pingüical, Querétaro, where both taxa are found in their pure forms as well as with several grades of intermediates. Examples of sporadic hybrids between *A. bicolor* and other species of *Arbutus* are:

Arbutus madrensis x **A. bicolor**. Branchlets of second year rough, and lower surface of leaves with ferrugineous, somewhat floccose hairs indicate the influence of *A. madrensis*, whereas ovate, cordate at base leaves and densely glandular pubescent petioles are as in *A. bicolor*.

Durango: municipio San Dimas: Miravalles, UCODEFO 4, *S. González et al. 5118* (CIIDIR); municipio Durango: parque El Tecuán, 23°54' N, 105°01' W, *A. Román 5 y S. González* (CIIDIR); ibid., 23°54' N, 105°01' W, *A. Román 6 y S. González* (CIIDIR).

Arbutus bicolor x **A. occidentalis**. Several examples of hybrids between *A. bicolor* and *A. occidentalis* are recorded by González Elizondo et al. (in rev.). They are shrubs 0.15-2.5 m tall with small or medium sized leaves (which reveals influence of *A. occidentalis*) in which the lower surface is dense and uniformly pubescent with short, irregularly curled hairs (as in *A. bicolor*). These plants form populations in which the morphological characters are fixed and the plants seem to represent genetically differentiated populations. Known from Durango and southern Chihuahua, from 2440 to 2700 m. An additional example is represented by shrubs to 2.5 m tall with reduced inflorescences (at most 3 cm long) but with bicolored leaves and pubescence that indicates a stronger influence of *A. bicolor*.

Durango: municipio Tepehuanes: Paraje Chamacueros, 30 km al W de Mesa de Navar, 2860 m, *A. (Benítez) Paredes and O. Bravo 400* (CHAP, CIIDIR).

A. bicolor x **A. tessellata 1**. Glandular pubescence dense and short (at most 1 mm long) in branchlets and petioles as in *A. bicolor*, but older branchlets rough, leaves olive green, and flowers white yellowish, as in *A. tessellata*. The shape of leaves is intermediate between both species.

Michoacán: municipio Quiroga: ladera S del Cerro Tzirate, 2400 m *S. Zamudio 12866*, (IEB).

A. bicolor x **A. tessellata 2**. Glandular pubescence dense in branchlets and petioles, ovate leaves to 10.5 cm long, dark green above and whitish below (*A. bicolor*), but lacking the dense, contorted hairs, instead having long, flexuous, twisted hairs not hiding the surface, older branchlets rough, and longer glandular hairs 1.5-3 mm long (*A. tessellata*).

Michoacán: municipio Contepec: 5 km del camino Santa María Los Ángeles a Solís, 19°58'35" N, 100°7'3" W, 25.09.2004, *J. Martínez Cruz 1086, G. Ibarra Manríquez, M. G. Cornejo Tenorio y M. A. Salinas Melgoza* (IEB); ibid., 19°58'26"

N, 100°7'41" W, (fr) *J. Martínez Cruz 1055, G. Ibarra Manríquez, M. G. Cornejo Tenorio y M. A. Salinas Melgoza* (IEB).

Arbutus xalapensis x **A. bicolor**. Peripheral populations of *A. bicolor* with strong introgression of *A. xalapensis* have lower surface of leaves with both, shaggy, ferruginous, floccose hairs as in *A. xalapensis* and short, appressed, curled hairs as in *A. bicolor* (although less dense) as well as some glandular hairs in branchlets and petioles. In the Trans Volcanic Belt in central Mexico, in *Pinus* or *Abies* forests with *Baccharis conferta* scrub (the last indicating disturbance). 2800-3300 m.

Hidalgo: municipio El Chico: Las Ventanas, 5.5 km al N de Pachuca, *M. Medina 2273* (ENCB, IEB, MEXU). **Distrito Federal**: Cañada de Contreras, por encima del Pueblo, *F. Miranda s.n. 10 Dic. 1939* [other label indicates "Xochimilco", *F. Miranda 39*] (MEXU). **Tlaxcala**: municipio Tlaxco: 2 km al N de El Rosario, *A. Chimal et al. 27* (MEXU); Cerro El Rosario, 11 km al NO de Tlaxco de Morelos, 24 km Apizaco - Chignahuapan, 19°40'05" N, 98°10'25" W, 3300 m (flores blancas y rojo-amarillentas), 20.03.1988, *M. Ishiki & S. E. Pérez 1989* (CHAPA, IEB); municipio Terrenates: ladera S del cerro Tlajacolo, al W del rancho Atotonilco, *C. Castillejos 108* FES-ZA (MEXU). **Veracruz**: municipio Perote: camino a El Paisano, 19°34' N, 97°06' W, *P. Zamora G., G. Castillo Campos 2159* (IEB).

A. bicolor x **A. xalapensis** var. **texana**. Hybrid swarm. Known from the Cerro El Pingüical, Querétaro, between 3000 and 3250 m asl in pine-oak-madrone forest as well as in disturbed *Quercus* scrub with *Baccharis, Cercocarpus, Garrya*, and *Arbutus*.

Both parents are present in the area in their pure forms as well as with several grades of intermediates with respect to habit and size of the plants (short shrubs to trees to 5 m tall), size of leaves, type and density of pubescence and glandularity (often with mixture of short, tightly curled hairs and long, floccose hairs).

Querétaro: municipio Peñamiller: parte alta del Cerro Pingüical, *S. Zamudio y S. González 11718* (IEB); ibid., ladera SW, casi en la cima, *S. Zamudio y S. González 11722* (IEB); ibid., ladera S, *S. Zamudio y S. González 11725* (IEB); ibid., *S. Zamudio y S. González 11731* (IEB); ibid., *S. Zamudio y S. González 11732* (IEB).

Peripheral populations of *Arbutus bicolor* from Hidalgo (e.g. *Benítez 191*; *Medina and Barrios 2579*) have short inflorescences with only 2-3 racemes and relatively narrow leaves, the upper surface glabrescent and more or less smooth (veinlets not raised), probably due to past occurrence or continuing sporadic hybridization with *A. xalapensis* var. *texana*.

Markedly bicolor leaves are also found in two other *Arbutus* taxa, but they lack the dense indument of short, tightly contorted hairs characteristic of the leaves of *A. bicolor*: a) *Arbutus xalapensis* var. *texana*, with coriaceous to subcoriaceous leaves, very pale green to pale yellowish green or glaucous below, glabrous or with straight to wavy or twisted hairs never obscuring the surface; b) *Arbutus cf. xalapensis*, only known from western Chihuahua, which has ovate-lanceolate, acute, narrow (<3.8 cm wide) leaves pale green below, with sparse, fine, ferruginous hairs not hiding the lower surface, as well as long peduncles up to 1.6 cm long; the indumentum appears to indicate influence of *A. xalapensis* but the shape and bicolored character of the leaves and long peduncles appear to be unique.

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